NASA/JAXA Joint Program

Validation of AMSR Sea Ice Antarctic Parameters

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Validation of AMSR-E Sea Ice Antarctic Parameters

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Scientific Motivations

- Confirm the range of applicability of the assumptions made in the AMSR sea ice algorithm
- Assess the accuracy of the AMSR sea ice parameters
- Enhance our current understanding of the sea ice cover as observed by satellite sensors. Accurate interpretation is needed for polynya studies, heat and salinity flux calculations, and climate change/trend analysis.

Validation Schedule (ADEOS2/AMSR: Sea Ice)
-Post lauching-

	Arctic & Okhotsk Sea	Antarctic Ocean & Continent
Dec.14, 2002	**ADEOS2 launching**	**ADEOS2 launching** New Glaciological Program(JARE) 5-year term Wintering at Showa St. (GLI Receiving)
2003	**Arctic flight** **Okhotsk Sea** Field experiments(February~March) Aircraft(P3.) Icebreaker, field campaign	**Antarctic Campaign** **(August~September, NASA)** **Weddell Sea & Belingshausen** **(P3, Icebreaker)** **=Canelled!**
2004	**Arctic Sea & Okhotsk Sea** Flight over Okhotsk Sea **Okhotsk Sea** Field experiments(February~March) Aircraft(Pi-SAR) Icebreaker, field campaign ALOS;launch?	**Antarctic Campaign** **(September, NASA)** **Weddell Sea & Belingshausen** **((P3)**
2005	**Okhotsk Sea** Field experiments (February~March) Aircraft(PiSAR) Icebreaker, Field campaign	**Antarctic Campaign** **(NASA) P3 Ross Sea Region** **aircraft, Icebreaker**
2006	**Okhotsk Sea** Field experiments(February~March)	**Antarctic Campaign** **(JARE**) winter(August~October) near Syowa St. & Ice sheet to inland
2007	**Okhotsk Sea** Field experiments(February~March)	**IPY campagain** ***IPY(International Polar Year;2007~09)**

Validation Issues

- **Absolute Accuracy-IC, ice temperature, and snow depth**
- **Effect of different ice types and surfaces**
- **Definition of the ice edge(5-15%)**
- **Accuracy of land mask**
- **Accuracy of ocean mask**
- **Accuracy of land/ocean boundary**

Validation Options

- Aircraft underflight (P3)
- Use of high resolution satellite data
  (Landsat7, MODIS, SAR)
- Use of station/ship data(ice, snow and sea ice measurements)
- Radiative transfer and sea ice modeling
- A combined use of all 4 techniques

Validation Tools

- P3 Aircraft – coordinate with Aqua orbit

  PSR A & C – Sensor calibration and parameter studies

  ATM – ice thickness and topography studies

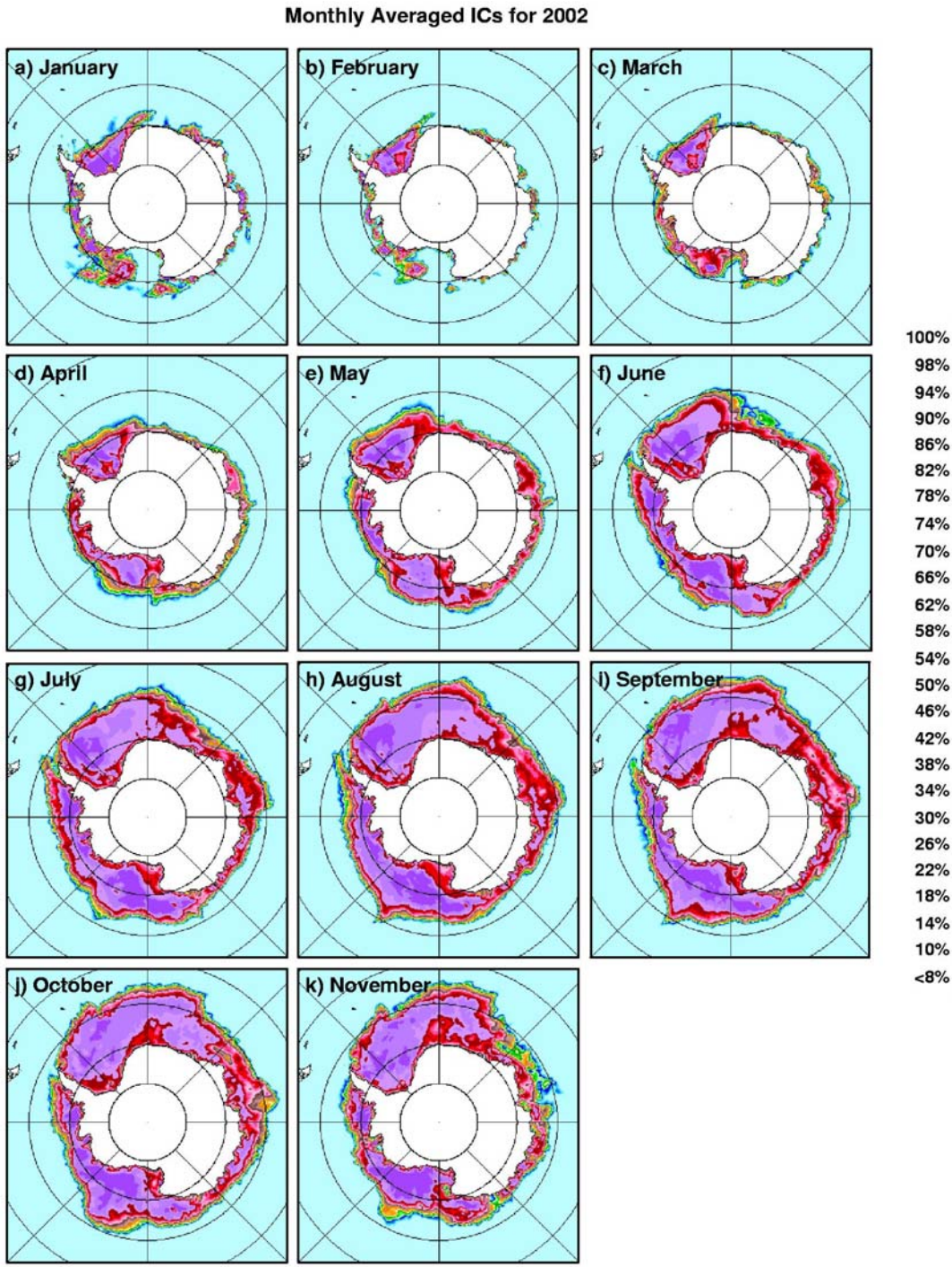
  THOR – snow thickness and cloud cover studies

  D2P – ice and snow thickness studies

  TAMMS – heat and humidity flux studies
- Ship Observations- in situ data of passive microwave observations and physical characterization of the ice
- High Resolution Satellite Observations – Landsat, ASTER, Ikonos
- Radiative Transfer Modeling Studies

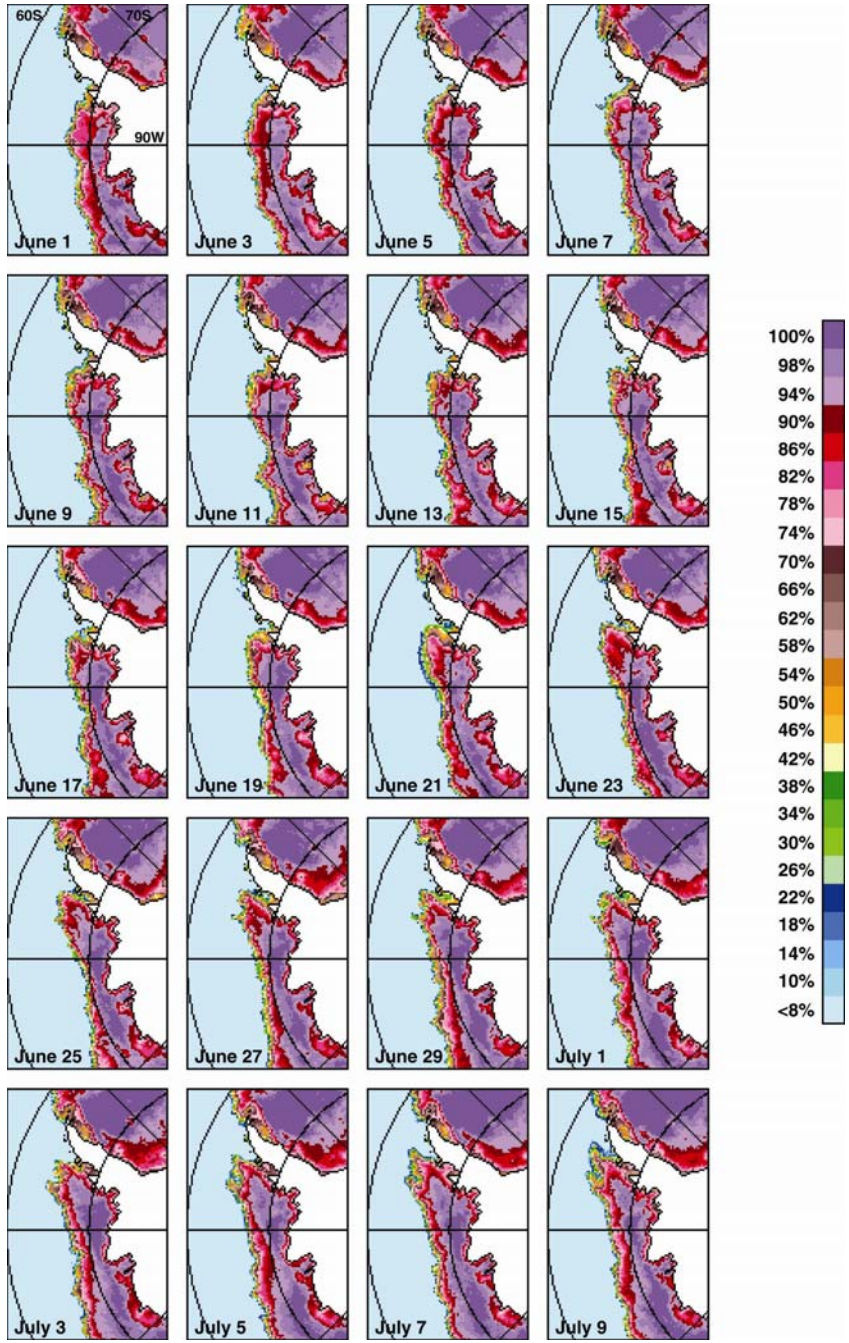
Seasonal Ice Cover in 2002

- For the first time in the satellite era, the Northern tip of the Antarctic Penninsula was ice free in January thru March.
- The multiyear ice cover in the B/A seas was very minimal



Ice Concentrations in the B/A region in June 2001

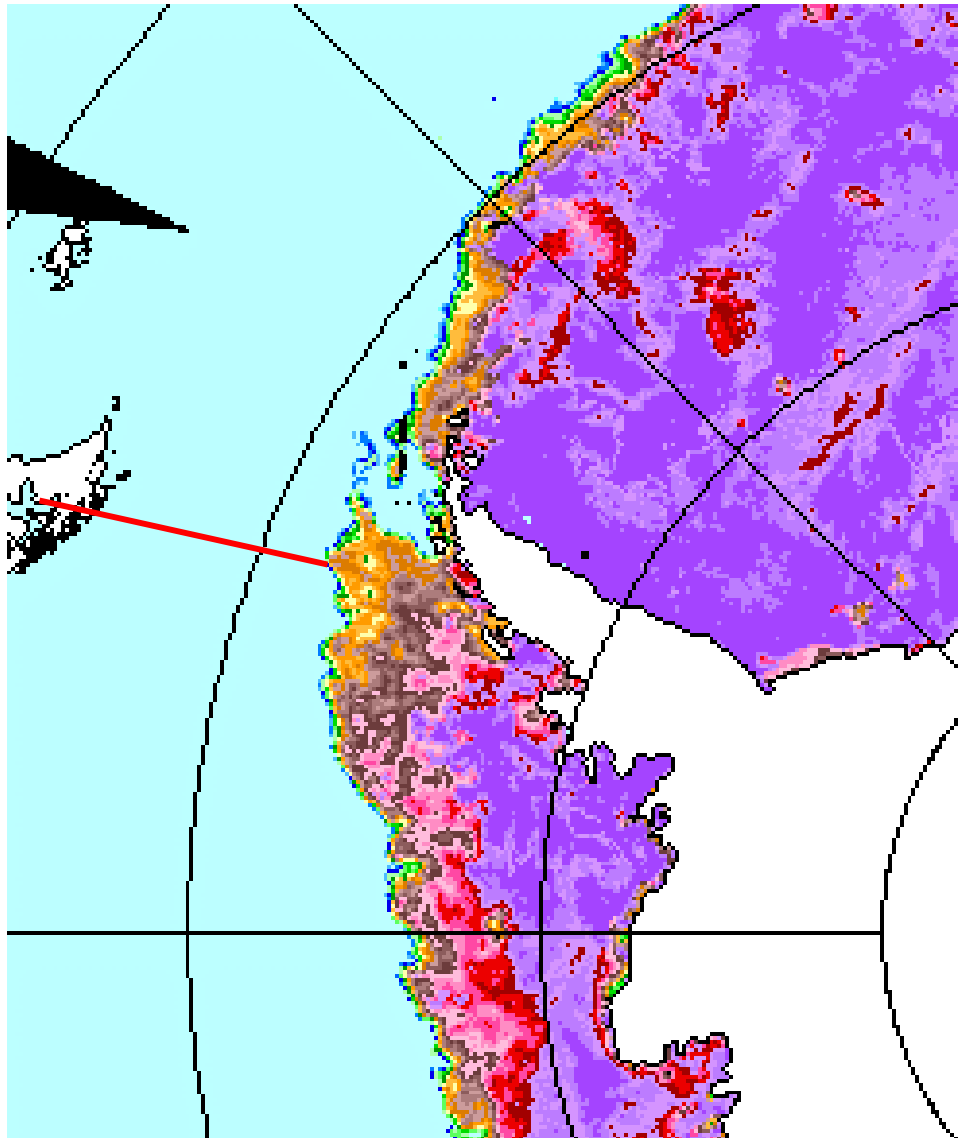
- Freeze up at the Marguerite Bay did not occur until late June.
- The ice cover along the western part of the Antarctic Peninsula are generally loss/new ice.



Recent Sea Ice Cover, 24 August 2003

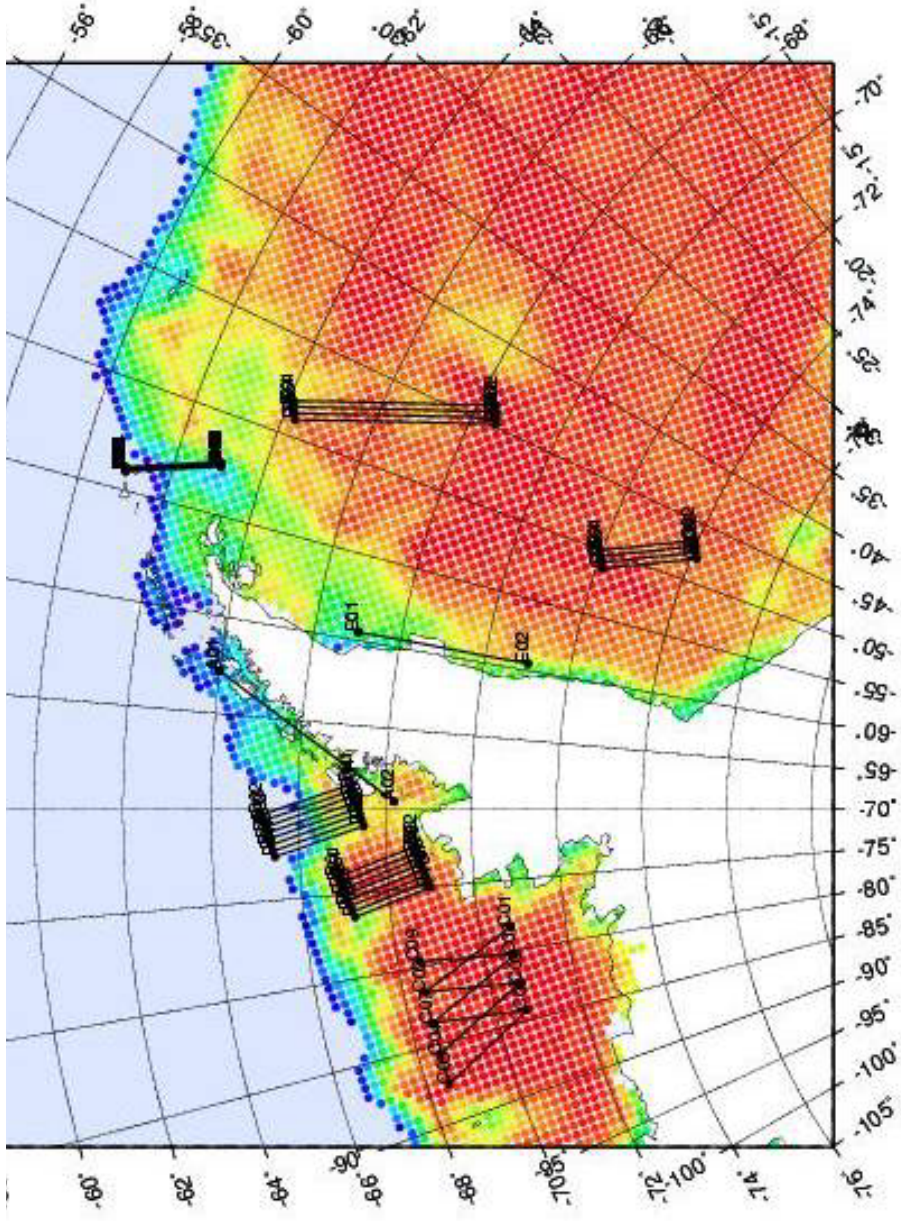
- Wind can be a strong factor affecting the extent of the ice cover

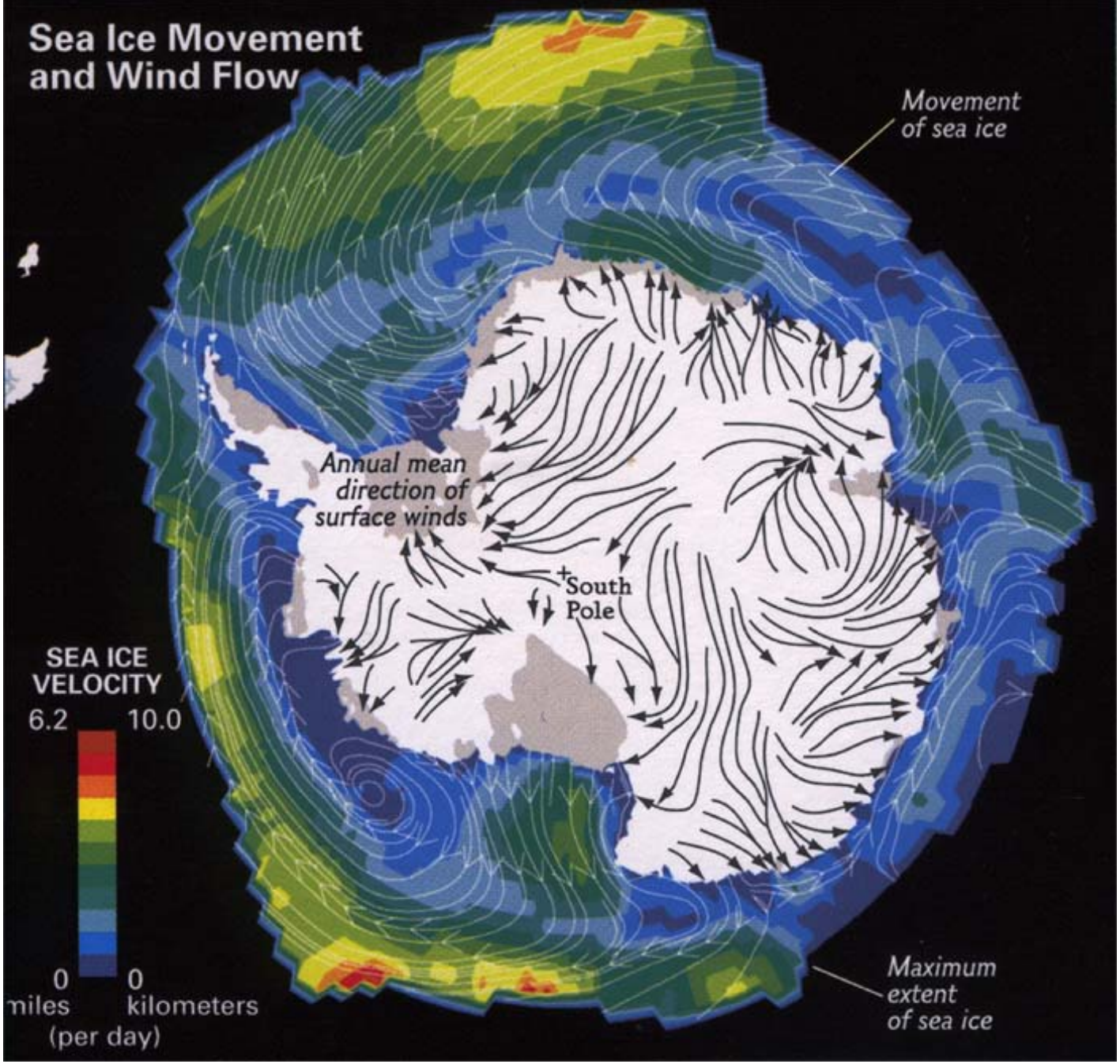
- New ice is a key source of uncertainty since it has unpredictable emissivity



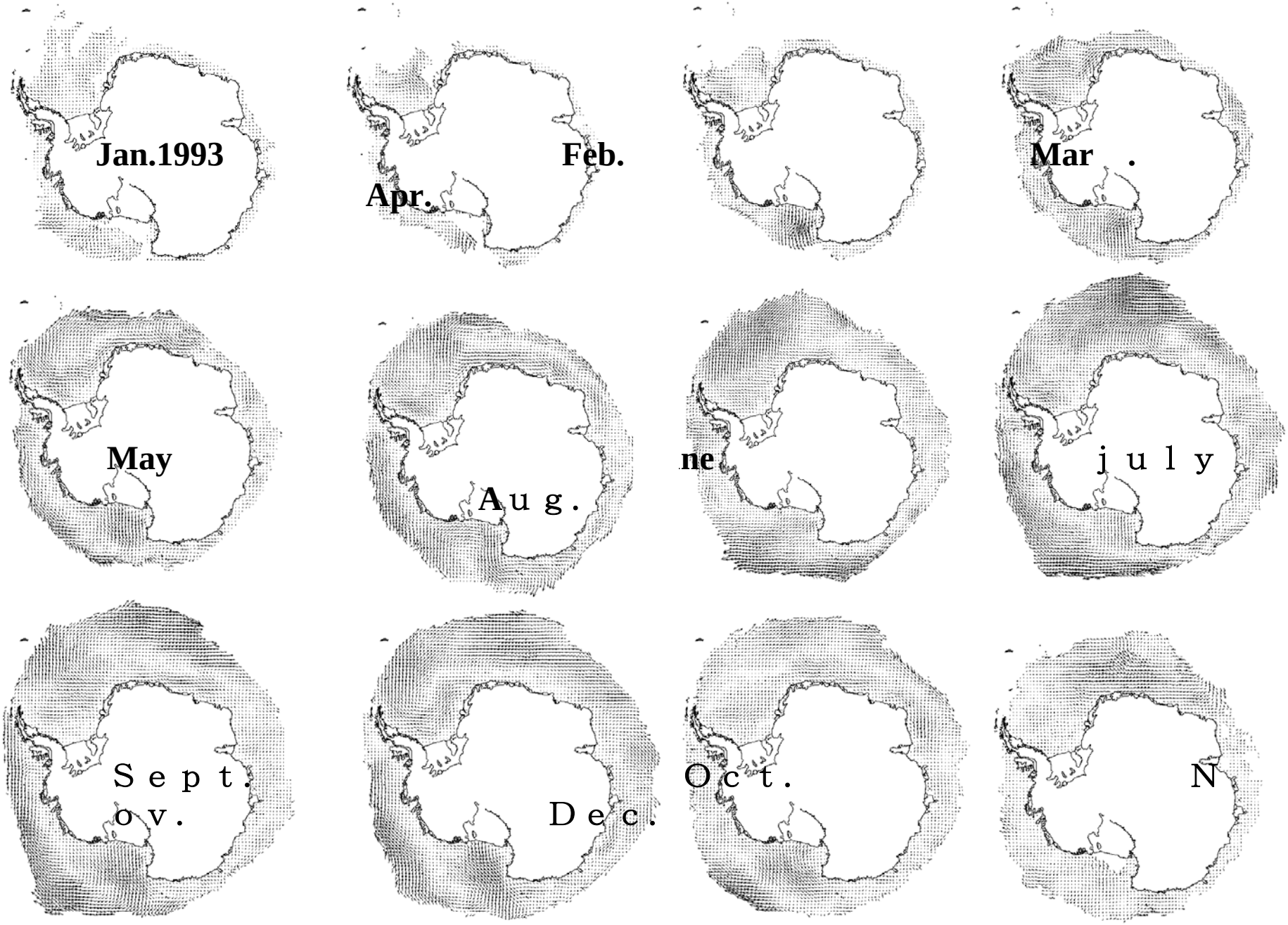
Flight Pattern Rationale/Strategy

- Coastal Polynya Studies (thin ice, flux, land contamination)- H&L alt.
- Marginal Ice Zone (pancake, ice bands, ice edge location)- H&L alt
- Inner Pack/emissivity variability – H alt
- Inner Pack/topography, snow, flooding – H&L alt





Sea ice velocity data: M. R. Drinkwater, European Space Agency; Surface winds data based on data from D.H. Bromwich, Ohio State Univ. and T.R. Paris, Univ. of Wyoming

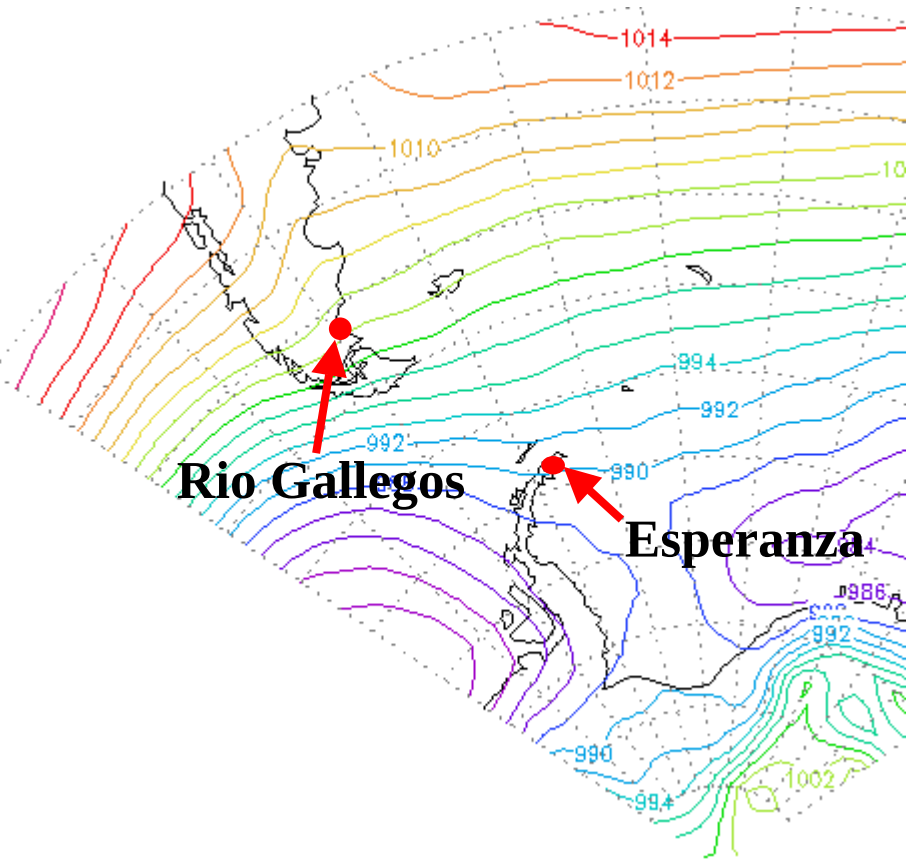


Data:

Drake passage Oscillation Index

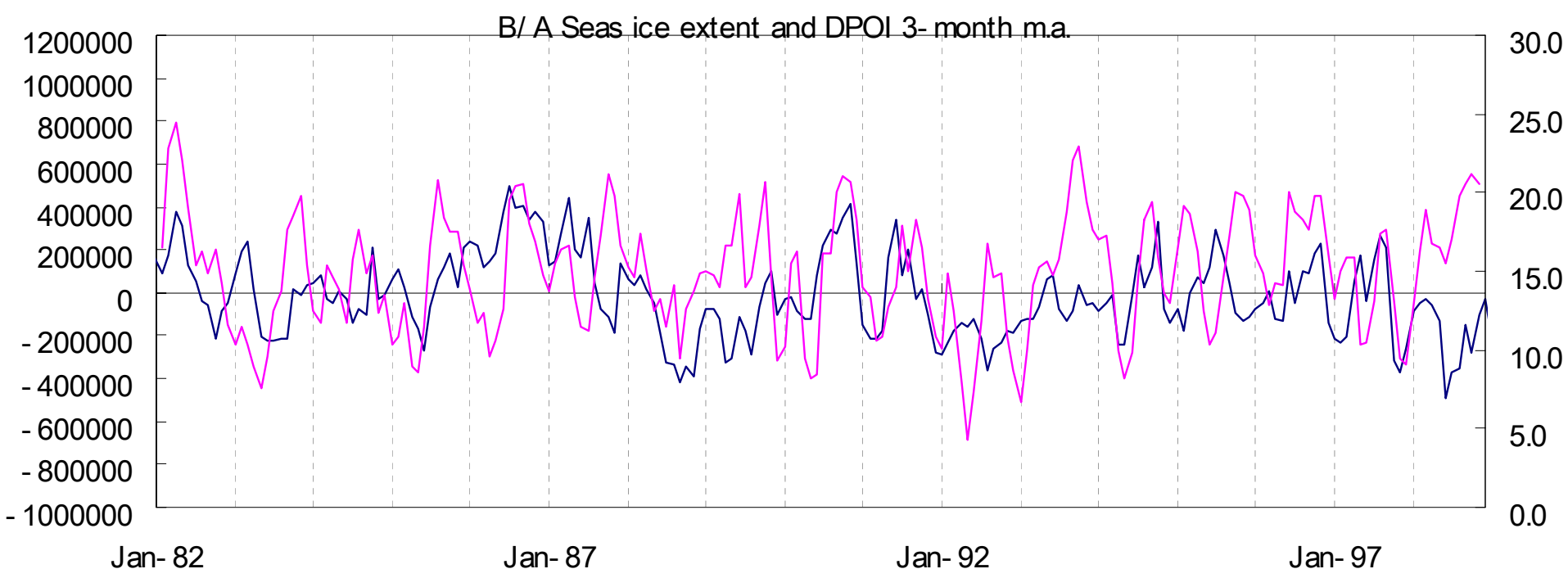
Difference in monthly mean sea level pressure between Rio Gallegos and Esperanza Stn. (Naganobu et al., 1999)

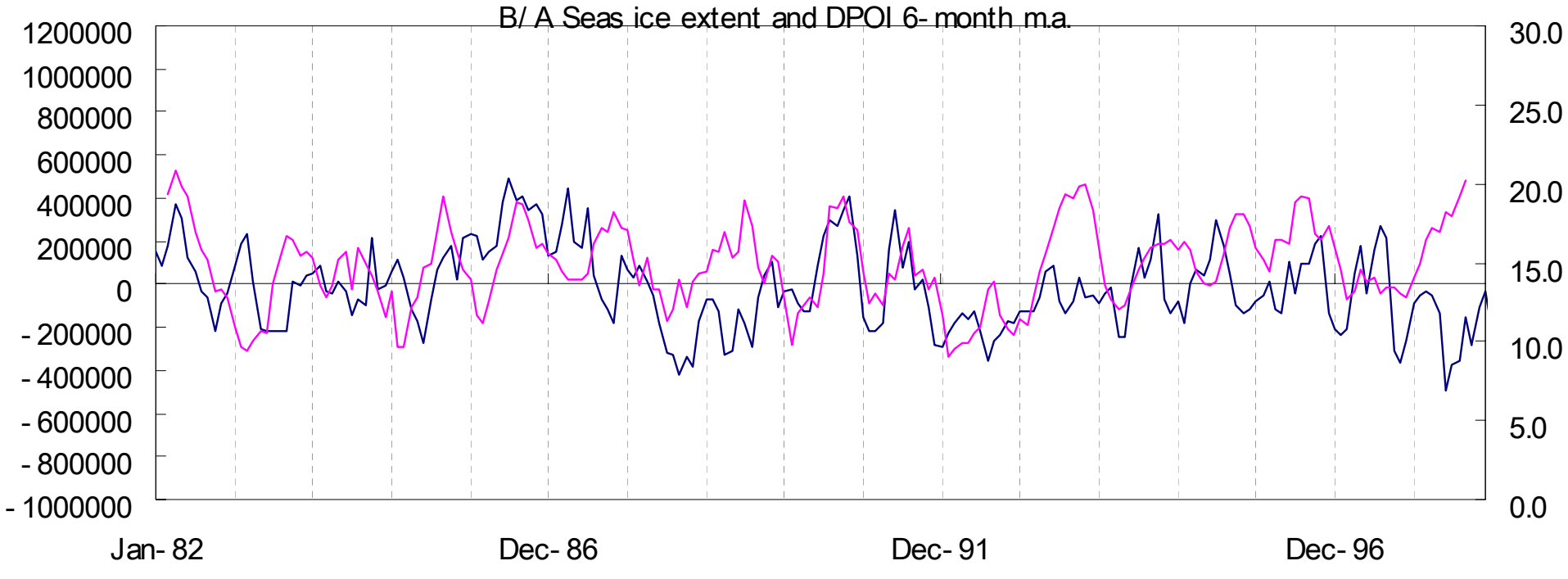
Represents strength of westerly wind across Drake Passage

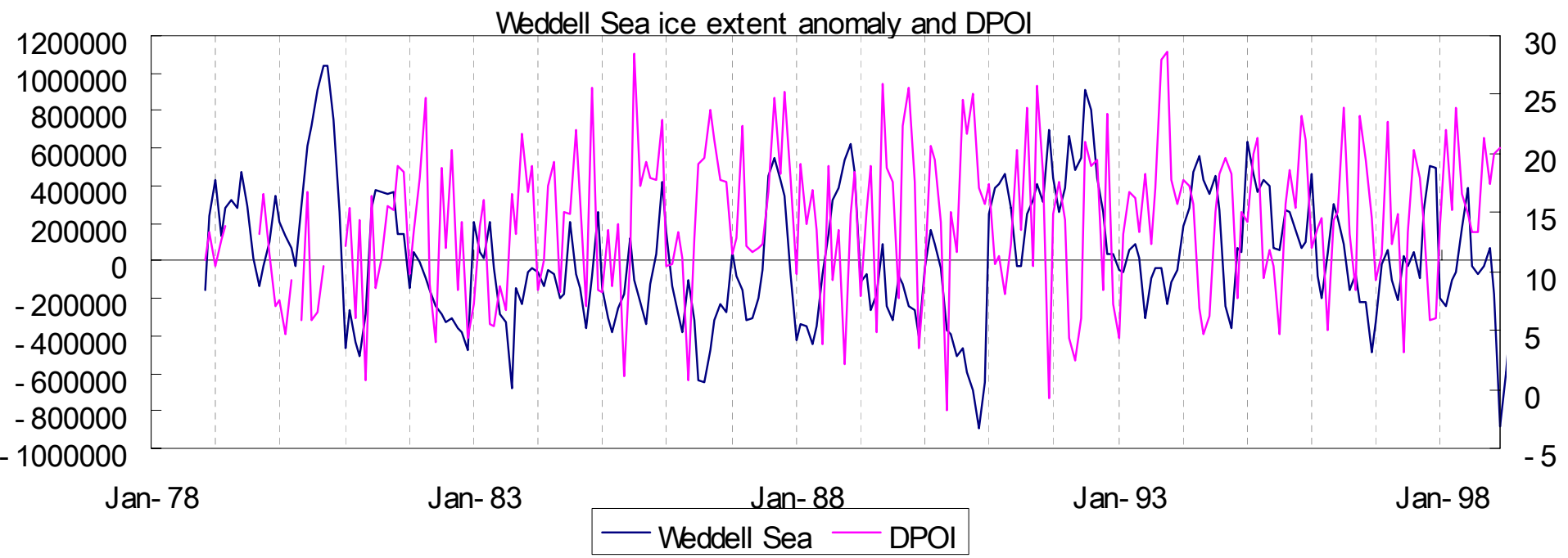


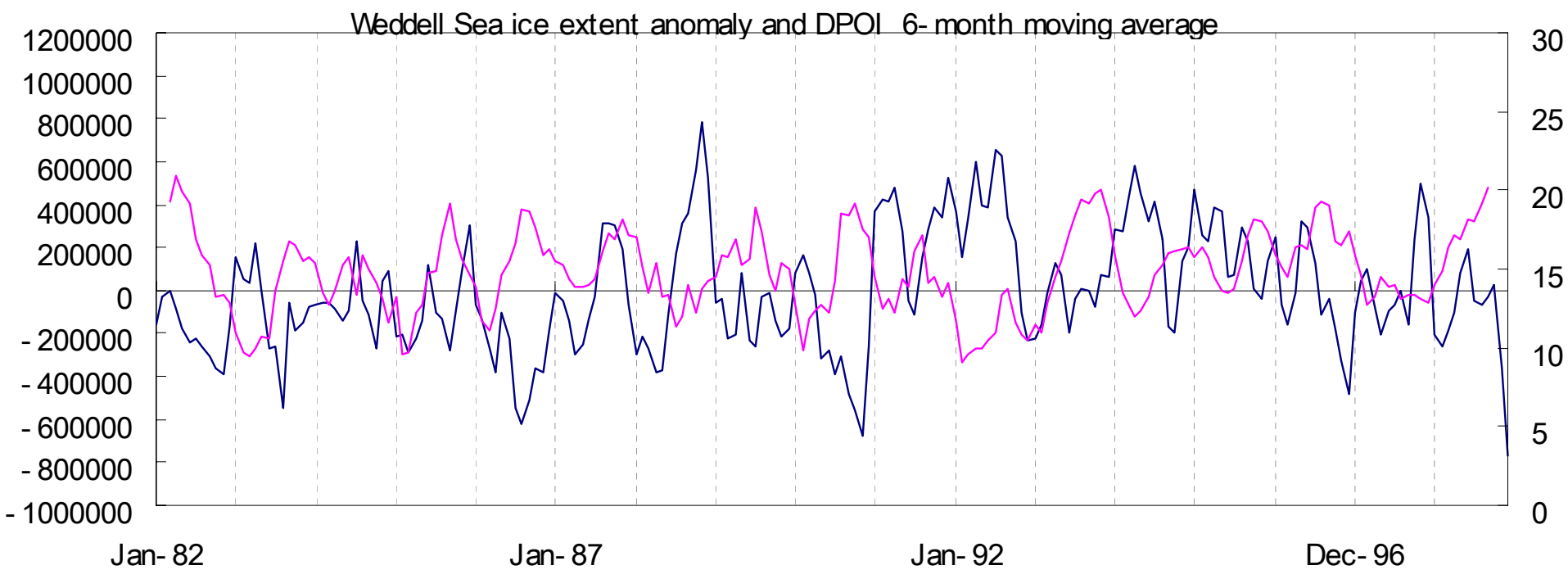
The direction of wind induced Ekman Transport is toward the left side of the wind direction in Southern Hemisphere

Sea ice is driven northwards, should affect sea ice extent


B/ A Seas ice extent and DPOI 3- month m.a.
1200000
1000000
800000
600000
400000
200000
0
- 200000
- 400000
- 600000
- 800000
- 1000000
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Jan- 82
Jan- 87
Jan- 92
Jan- 97


B/ A Seas ice extent and DPOI 6- month m.a.
1200000
1000000
800000
600000
400000
200000
0
- 200000
- 400000
- 600000
- 800000
- 1000000
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Jan- 82
Dec- 86
Dec- 91
Dec- 96

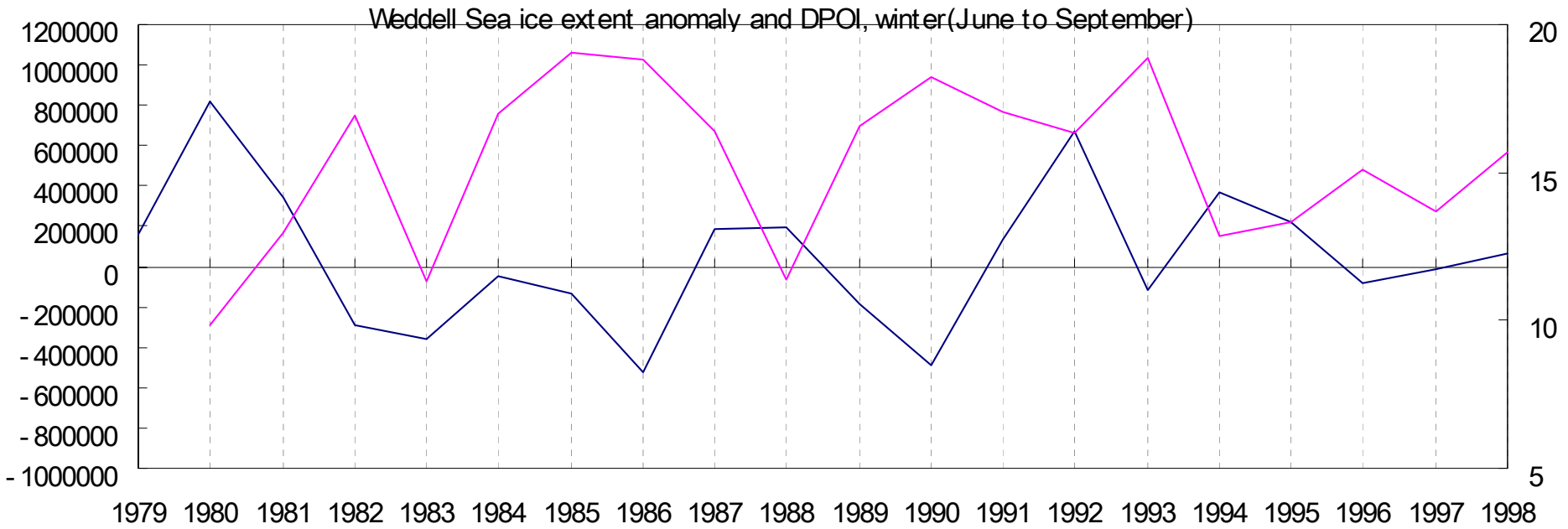

Weddell Sea ice extent anomaly and DPOI
1200000
1000000
800000
600000
400000
200000
0
- 200000
- 400000
- 600000
- 800000
- 1000000
30
25
20
15
10
5
0
- 5
Jan- 78
Jan- 83
Jan- 88
Jan- 93
Jan- 98
Weddell Sea
DPOI


Weddell Sea ice extent anomaly and DPOI 6- month moving average
1200000
1000000
800000
600000
400000
200000
0
- 200000
- 400000
- 600000
- 800000
- 1000000
30
25
20
15
10
5
0
Jan- 82
Jan- 87
Jan- 92
Dec- 96

DPOI and sea ice in Weddell Sea

•It is difficult to see the relationship when data from all month are used.

There seems to be a negative correlation, but the correlation coefficient is insignifican (-0.14).



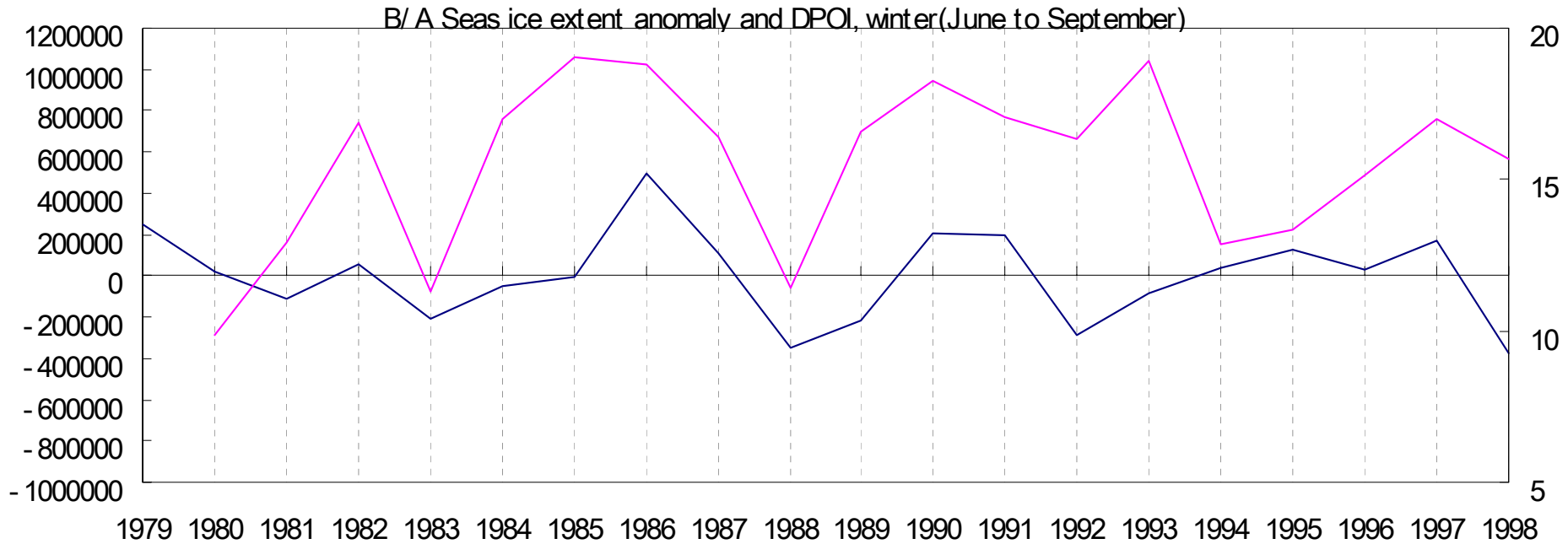
Winter(June to September only, correlation coefficient is –0.55

Sea ice extent in Weddell Sea is negatively correlated to the westerly wind across Drake Passage.

DPOI and sea ice in Bell./Amun. Seas

•It is difficult to see the relationship in all-season data.

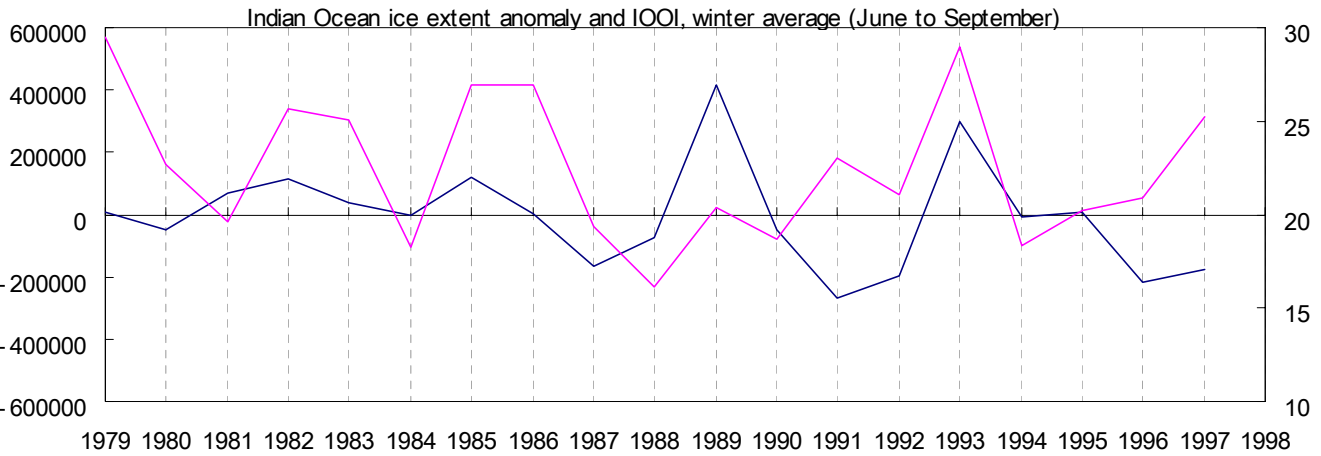
There seems to be a positive correlation, but the correlation coefficient is insignifican (0.12).



Winter only, correlation coefficient is 0.38

Sea ice extent in Weddell Sea is positively correlated to the westerly wind across Drake Passage.

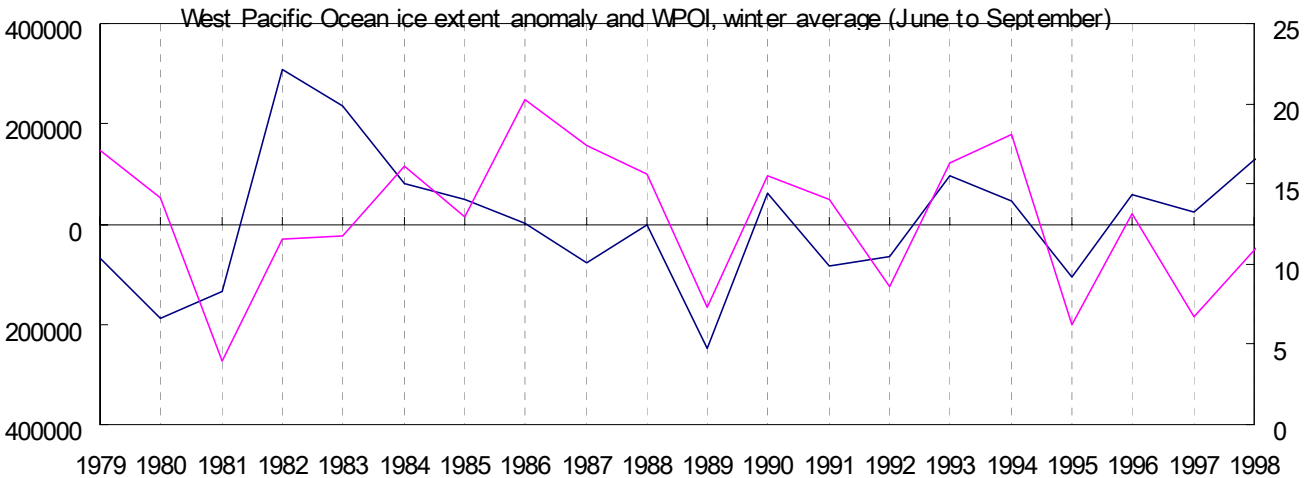
Indian Ocean and West Pacific Ocean



Indian Ocean

Marion Island - Syowa Stn.

Positive correlation?



West Pacific Ocean

Macquaire Island – Dumont D'Urville Stn.

Positive correlation after 1988 (r=0.56)

Summary

- A more dependable P3 aircraft is highly desirable, especially since operations are usually very expensive & others?
- Aircraft data are very useful especially in sorting out effects of various components of the ice pack.
- High resolution AMSR/E data are shown to be consistent with MODIS and Landsat data and can be useful for mesoscale studies when atmospheric effects are not critical.

Further Studies

- Implement the AASI-2004 Campaign?
- Complete analysis of Sea of Okhotsk 2003 and AASI-2003 data
- Analysis of high resolution satellite data for all regions and all seasons
- Analysis of highly rsolution data with ENSO, ACO, etc
- Radiative Transfer Modeling Studies to improve interpretation of radiometer data over sea ice